CLAIMS

1. A method of determining an end point to a charged particle beam process, comprising:

directing a charged particle beam in a pattern onto a work piece, the pattern being repeated periodically and the beam being blanked between repetitions of the pattern, the repeated blanking defining a blanking frequency;

detecting an output signal caused by the impact of the particles in the charged particle beam onto the work piece, the output signal including a secondary particle signal or a stage current signal;

providing the output signal to a circuit adjusted to improve the signal-to-noise ratio of a signal at the blanking frequency;

monitoring the output of the circuit to detect a change in the material at the impact point of the charged particle beam.

2. The method of claim 1 in which providing the output signal to a circuit adjusted to improve the signal-to-noise ratio of a signal at the blanking frequency includes providing the output signal to a lock-in amplifier.

3. The method of claim 1 in which providing the output signal to a circuit adjusted to improve the signal-to-noise ratio of a signal at the blanking frequency includes providing a reference signal having a frequency that is substantially the same as of the blanking frequency.

4. The method of claim 3 in which providing a reference signal having a frequency that is substantially the same as of the blanking frequency includes adjusting the phase of the reference signal to maximize the amplifier output.

5. The method of claim 1 in which directing a charged particle beam to the work piece includes directing a focused ion beam to an insulating material covering a conductor and in which monitoring output of the frequency sensitive amplifier includes monitoring the detector signal to detect a change in the amplifier output indicating that the insulating material has been substantially removed and the ion beam is impinging upon the conductor.

6. The method of claim 1 in which directing a charged particle beam to the work piece includes directing an electron beam to an insulating material covering a conductor and in which monitoring output of the frequency sensitive amplifier includes monitoring the detector signal to detect a change in the amplifier output indicating that the insulating material has been substantially removed and the electron beam is impinging upon the conductor.

7. The method of claim 1 in which the blanking frequency is between about 100 Hz and about 500 Hz.

8. The method of claim 1 detecting an output signal caused by the impact of the particles in the charged particle beam onto the work piece includes detecting a stage current signal.

9. The method of claim 1 detecting an output signal caused by the impact of the particles in the charged particle beam onto the work piece includes detecting a secondary electron signal.

10. The method of claim 1 in which monitoring the output of the circuit to detect a change in the material at the impact point of the charged particle beam includes generating a detector signal from a current generated by the charged particle includes detecting a current of

secondary charged particles ejected from the work piece by the interaction of the charged particle beam with the surface or detecting a stage current.

11. The method of claim 6 in which directing a charged particle beam to the work piece includes directing a focused ion beam or an electron beam to the work piece.

12. The method of claim 6 in which electronically monitoring the detector signal includes periodically sampling secondary charged particle current.

13. The method of claim 1 in which providing the output signal includes providing an output signal that is not provided by way of an electrical conductor attached to the work piece.

14. A method of altering an element of an integrated circuit by using a charged particle beam, comprising:

charged particle beam milling through one or more layers of material to expose the circuit element;

detecting an output signal caused by the impact of the focused ion beam, the output signal including a secondary charged particle signal or a stage current;

providing the output signal to a circuit adjusted to improve the signal-to-noise ratio of a signal at the blanking frequency;

ceasing to mill when the output of the circuit adjusted to improve the signal-to-noise ratio of a signal at the blanking frequency changes more than a predetermined amount, the change indicating a change of material impacted by the charged particle beam.

15. The method of claim 14 in which ceasing to mill when the output of the circuit adjusted to improve the signal-to-noise ratio of a signal at the blanking frequency changes more

than a predetermined amount includes ceasing to mill when the element is uncovered and before the element is severed.

16. The method of claim 14 further comprising milling through the exposed element and in which ceasing to mill when the output of the circuit adjusted to improve the signal-to-noise ratio of a signal at the blanking frequency changes more than a predetermined amount includes ceasing to mill when the exposed element is severed.

17. The method of claim 14 in which the frequency sensitive circuit is a lock-in amplifier, or a band pass filter.

18. The method of claim 14 in which the output signal is determined from a current of secondary electrons ejected from the work piece.

19. The method of claim 14 in which the blanking frequency is between about 100 Hz and about 500 Hz.

20. A method of determining a change in a work piece undergoing charged particle beam processing, comprising:

applying a modulating signal to a conductor within the work piece being processed;

directing a charged particle beam to the work piece;

generating a detector signal from a current generated by the charged particle beam, the current correlated to the material being processed by the charged particle beam;

electronically monitoring the detector signal to detect an influence from the modulating signal, a change in the influence of the modulating signal indicating that the material being processed by the material particle beam has changed.

21. The method of claim 20 in which applying a modulating signal includes applying a modulating signal having a frequency component and in which monitoring the detector signal includes processing the signal using a circuit sensitive to the frequency component to enhance detection of the frequency component in the detector signal.

22. The method of claim 21 in which processing the signal using a circuit sensitive to the frequency component includes processing the signal using a lock-in amplifier.

23. The method of claim 21 in which processing the signal using a circuit sensitive to the frequency component includes processing the signal using a band pass filter.

24. The method of claim 20 in which processing of a conductor on the work piece is characterized by a breakthrough period and in which applying a modulating signal includes applying a modulating signal having a frequency greater than the inverse of the breakthrough period and less than one half of the ion beam frequency.

25. The method of claim 20 in which applying a modulating signal includes applying a modulating signal having a frequency of between 3 Hz and 500 Hz.

26. The method of claim 20 in which applying a modulating signal includes applying a modulating signal having a frequency of between 10 Hz and 60 Hz.

27. The method of claim 20 in which generating a detector signal from a current generated by the charged particle includes detecting a current of secondary charged particles ejected from the work piece by the interaction of the charged particle beam with the surface or detecting a stage current.

28. The method of claim 20 in which directing a charged particle beam to the work piece includes directing a focused ion beam or an electron beam to the work piece.

29. The method of claim 20 in which electronically monitoring the detector signal includes periodically sampling secondary charged particle current.